BEE's National Program
on
Energy Efficiency and Technology Up-gradation in SMEs

Ludhiana Forging Cluster

Baseline Energy Audit Report
Kalhon International

Submitted to

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InsPIRE Network for Environment

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Brief about the Project

The project BEE's National Program on "Energy Efficiency and Technology Up gradation in SMEs - Ludhiana Forging Cluster" supported by Bureau of Energy Efficiency (BEE), Ministry of MSME and Ludhiana Auto Parts Manufacturers Association aims to bring down the energy demand of forging industries located at Ludhiana by supporting them to implement Energy Efficient Technologies in the SME units.

Executive Summary

1. Unit Details

Unit Name		**Kalhon International**
Address	:	C-26, Phase-II Focal Point, Ludhiana
Contact Person	:	Mr. Tej Prakash Mishra / Mrs. Pritam Kaur, Mr. Jashandeep Singh Kahlon (Owner) (Cell No: 7837638337)
Products	:	Bolts, Nuts and Auto Parts
Production	:	1000 Kgs per day
Account Number	:	030091200250 (Part-II)
Bank Details	:	State Bank of India; SME Branch – Ludhiana Account No. 10318976943; IFSC Code – SBIN0006265
TIN / PAN No.	:	PAN: ACDPM6432B
Contract demand	:	630 kVA

2. Existing Major Energy Consuming Technology

Lathes Machine

- Manually operated lathe machines for machining job work including threading, turning, grinding, drilling etc.
- Electrical motor rating of 3 HP with production of 80-100 pieces per hour per set of lathe machine.

3. Proposed Energy Saving Technologies with Cost Economics

Proposed Energy Saving Measures

- Replacement of manual lathe machines by four numbers of CNC based Special Purpose Machine (SPM) for carrying out machining operation

Table 1: *Cost Economic Analysis*

Technology	Estimated Energy Savings (%)	Savings	Investment	Simple Payback period (Years)
SPM – Turning Machine (4Nos)	83	1,652,402	2,200,000	1.33
	Total	**1,652,402**	**2,200,000**	

Introduction

1.1 ABOUT THE UNIT

M/s Kalhon International was manufacturing of different types of centre bolts, nuts and bolts, centre bolt flat type and auto fasteners in various sizes as per the customer requirement. The manufacturing unit is located at C-26, Focal Point, Ludhiana- Punjab - 141010

The raw material procured by the unit for making bolts and other auto components include Mild Steel, EN8, EN15 etc.

The production of M/s Kalhon International lies in the range of 1 tonnes/ day. The unit is using two different forms of energy for various process and utility applications in premises, those are:

- Furnace Oil (FO)
- Electricity

The average monthly FO consumption is 925 liters whereas the average monthly electricity consumption comes around 37121 kWh.

To manufacture the products, the unit has installed a FO based re-heating furnace, forging press, pressing machine, grinding/ facing/ trimming lathes, threading machine, cold forging hammers, nut making machines, drawing machine etc.

According to the assessment of the energy consumption data collected, the specific thermal energy consumption and specific electrical energy consumption is 0.05 L/kg (510 kcal/kg) of product and 0.38 kWh/kg (332.30 kCal/kg) of product respectively. The total specific energy consumption (in kCal) is 842.30 kCal/ kg of product. Details of annual electrical and thermal energy consumption and specific energy consumption details in M/s Kalhon International is presented in table below:

Table 1.1: ***Details of M/s Kalhon International***

SN	Parameter	Value	Unit
1	Name and address of unit	M/s Kalhon International, C-26, Focal Point, Ludhiana-141010	
2	Contact person	Mr. Jashandeep Singh Kahlon	
3	Manufacturing product	Bolts, Nuts and Auto Parts	
4	Daily Production	1000 Kgs	
	Energy utilization		
5	Average monthly electrical energy consumption	37121	kWh per month
6	Average monthly thermal (FO) energy consumption	925.8333333	Liters per month
7	Average thermal specific energy consumption	0.037033333	Liter /kg of product
		377.74	kCal/kg of product
8	Electrical specific energy consumption	1.48	kWh/Kg of product
		1276.97	kCal/kg of product

SN	Parameter	Value	Unit
9	Specific energy consumption	1654.71	kCal/kg of product
10	Electrical energy cost	11.14	Rs/Kg of product
11	Thermal energy cost	1.851666667	Rs/kg of product
12	Total energy cost	12.99	Rs/kg of product

Note:
^1: Specific gross calorific value of FO is considered as 10,200 kcal / liters
^2: Thermal equivalent for one unit of electricity is 860 kCal/kWh.
^3: The unit operates for 25 days a month.

1.2 PRODUCTION PROCESS OF PLANT

The following figure shows the typical process employed at manufacturing of forged products at M/s Kalhon International are presented below:

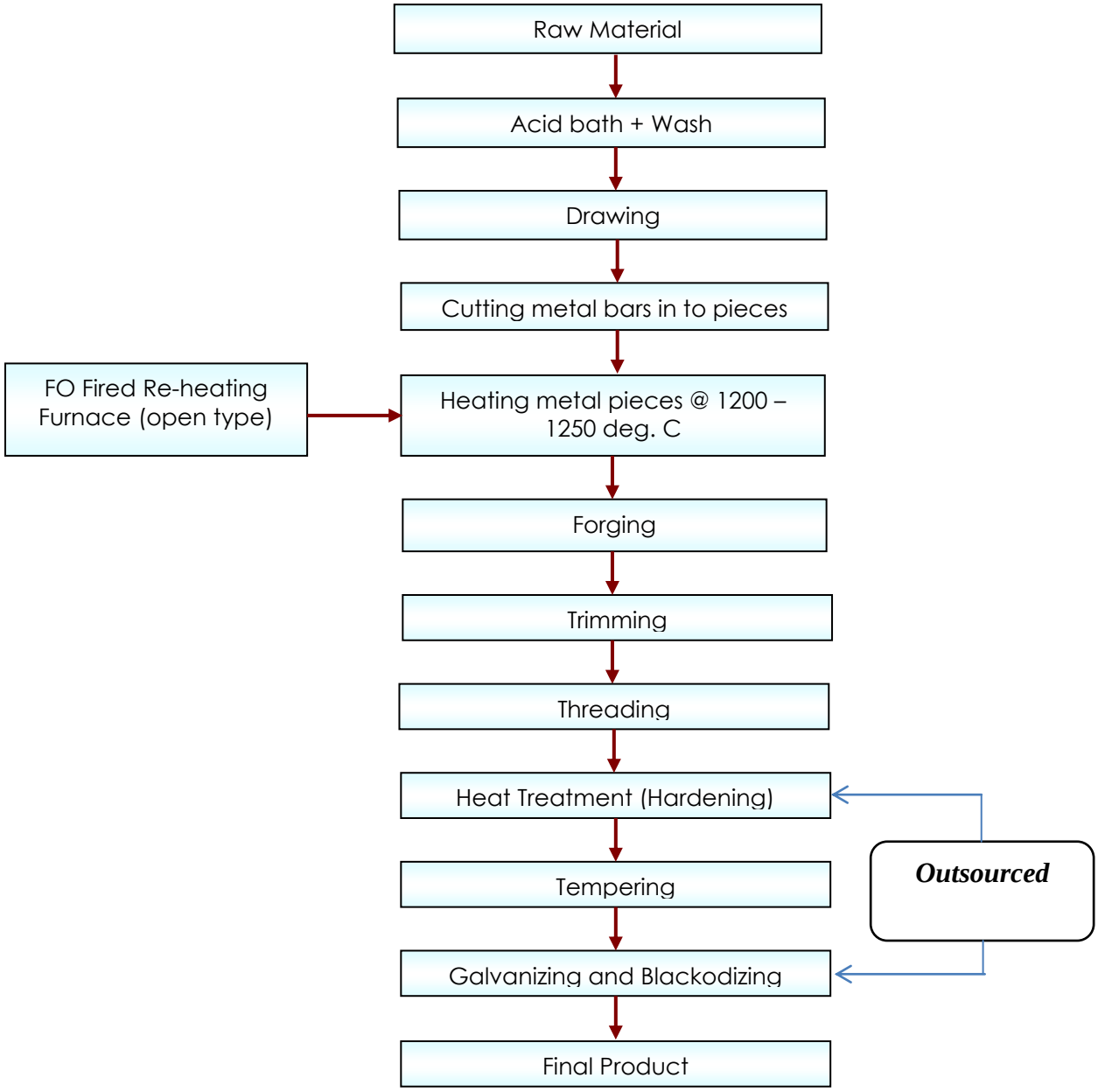

Figure 1.1: ***Flow chart of production process***

1.3 ENERGY AUDIT METHODOLOGY

The primary objective of the energy audit was to quantify the existing fuel consumption pattern and to determine the operating efficiencies of existing systems. The key points targeted through energy audits were determination of specific fuel consumption, various losses, operation practices like hot metal temperature, production, fuel consumption, scale formation etc. Pre – planned methodology was followed to conduct the energy audits. Data collected at all above steps was used to calculate various other operating parameters like material feeding rate (Kg/hr), fuel firing rate, specific fuel consumption (kg/tonne), etc.

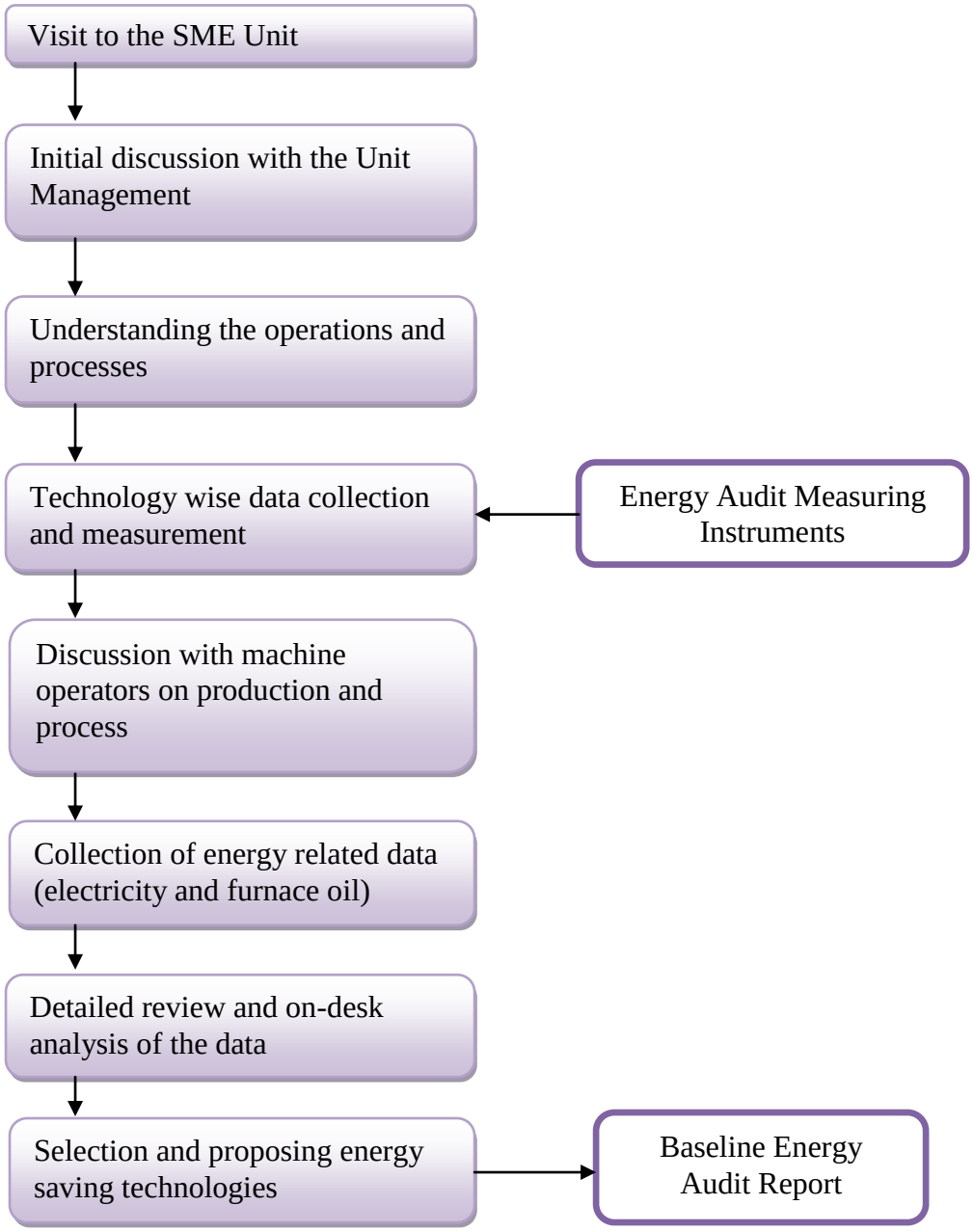

Figure 1.2: ***Energy audit process***

Study and Observations

2.1 RE HEATING FURNACE (FURNACE OIL FIRED)

2.1.1 Present Process

M/s Kahlon International has installed a Furnace Oil (FO) fired reheating furnace to heat the metal pieces for forging process. The metal pieces are kept inside the furnace and heated for a period of 15-25 mins. depending upon the size of the raw material and product to be formed. The metal piece to be forged is heated to a temperature of 1150-1200 deg. C. After that, the heated metal piece is then kept on the forging die having the cavity of the product to be formed. The hot metal piece then forged on the forging press into the product.

2.1.2 Observations

Some observations and drawbacks of the present re-heating FO technology:

- **Conventional Technology:**

The exiting furnace is very old installed in year 1996 and was fabricated by the local manufacturer without following any design standards. The burner used in the furnace is also based on the conventional design having manual control option for fuel firing rate.

- **Material deterioration:**

Since the flame of the furnace directly hits the surface of the metal during the heating period varying from 20 – 30 minutes deteriorates the atomic/ grain structure of the piece and also leads to the higher scale formation due the oxidation of the metal at high temperature ultimately leading to material/ production loss. In order to attain the exact temperature profile of the material in less time, 3Ts has to be followed, Time, Turbulence and Temperature, if these three parameters can be followed in a right manner proper temperature can be archive in a minimum time, which would help in reducing the excessive heating of the material and reduction in scale loss.

- **High energy consumption:**

As per the data collected during the energy audit activity, the reheating furnace consumes around 0.3 liters of FO per kg of the production which higher if we compare the same with the latest technologies available in the market like induction heating furnace.

- **Low production rate:**

Since the existing furnace is open type and most of the heat of the flame goes out of the furnace leading to higher heating time and more fuel consumption. Because of this the material under heating takes time to attain the desired temperature profile and thus leads to the lower production rate. Apart from the open heating, labor handling the furnace also responsible for slower production rate due to their own unorganized pattern of working.

- **Environmental and Health Issues:**

The existing reheating furnace requires furnace oil as a source of energy which is burnt to heat the metal pieces. The burning of FO releases harmful gases like CO, CO_2, SO_X, NO_X, smoke etc. During the preliminary visit, it was also noted black soot is coming out of the furnace and getting deposited in the factory itself. The black soot is basically due to the incomplete combustion of the FO, which ageing reduces the efficiency of the furnace and increases the fuel loss. The furnace has no exhaust mechanism, ID fan and flue gas pipe, to pass the flue gases out of the factory. All these factors affect the environment and also the health of the worker handling the furnace and other machineries installed in the factory.

- **Lack of skilled labour:**

Another factor which is creating the problem in Ludhiana is shortage of skilled workforce. Present re-heating technology requires 2-3 workers to control the furnace operations and feed in / discharge of material from the furnace.

- **Ideal running of forging press:**

It was noted that there is miss match between the operating capacity of the furnace and forging press. As studied, in a cycle of 5 minutes, the re-heating furnace produces only 10-13 pieces which were being forged in 2 minutes only the remaining 3 minutes the forging press runs ideal. During this ideal running time, the forging press only consumes energy instead of producing any output.

- **Choking at blower suction end:**

While studying the re-heating furnace, it was seen that the suction inlet of the blower is not working properly and there was no suction of the air.

- **Space constrained for storing fuel:**

It was observed during baseline audit, another big issue is fuel storage problem. Kalhon International has space limitations and there for finding problems with maintaining the inventory of the furnace oil in the unit.

2.1.3 Conclusion

Based on the above observations done during the study and discussions with the unit management it is proposed to replace the existing re-heating technology (FO Based) with Energy Efficient Induction Reheating furnace.

Benefits of the EE re-heating technology:

- Environmental cleaner technology
- Reduces Specific Energy Consumption
- Faster operation and reduced scale formation
- User friendly technology
- Improved quality of the product output
- Higher output with fewer crop cuts or short bars

2.2 SPECIAL PURPOSE MACHINES (SPM)

2.2.1 Present Process

M/s Kalhon International has installed manually operated conventional machines for various components machining job work like turning, undercut, threading, Nut threading etc. These machine runs on electrical motors having the capacity varying from 3 HP to 10 HP with production/ machining of 1000- 2000 pcs/day.

Table 2.1: ***List of conventional machine proposed for replacement / modification***

Machine	Numbers	Motor rating
Manual Lathe turning machine	4	3 hp

2.2.2 Observations

Since these machines are manually operated, the process through which components are manufactured is very slow and time consuming. Apart from the slow process, the components manufactured are not very precise and of high quality. Some times what happens that the machine keeps on running even there is no component on the machine or the operator is busy in some other work. All these factors lead to the loss of energy and production of low quality components.

2.2.3 Conclusion

In order to promote the energy efficiency and reduction in the overall energy cost in the factory, it is recommended to covert the existing manual machines into automatic special purpose machine (SPMs) by implementing PLC control mechanism or CNC machines. Since the modified machines will run on the pre-installed programming technique, the consumption of electricity will only happen when there is a function or operation required on the component. In the ideal condition the machine will remain in dead mode/ no operation mode.

Apart from the operation, the machine automatically loads the component for machining. The cycle time of the each component will be fixed in the business logic of

the PLC / SPM machine therefore each component will take specific time for processing or machining. The SPM machines results in 30-50% percent of the energy savings depending upon the type of component, operation, material, cycle time etc.

Benefits of the Automatic SPM/ CNC machines:

- Reduced energy consumption
- Faster operation and reduced down time
- Improved product quality and symmetrical product dimensions
- Higher productivity
- Environment friendly technology

2.2.4 Cost Economics Analysis

The comparison of production on old manual/ conventional lathe machine and modified SPM machine, specific energy consumption, cost savings, investment required and simple payback period of the investment on SPM machines is given in Table 2.2.

Table 2.2 ***Energy saving calculation for Automatic SPM Lathe-Turning Machine***

Parameter	Unit	Value
Power consumed by old manual lathe machine	kW	8.952
Production on manual lathe machine	Pcs/hr	100
Specific power consumption on manual machine	kWh/Pcs	0.090
Power consumed by SPM Lathe Machine (Turning/ undercut operation) (motor capacity 3 hp) @ 70% Loading	kW	4.476
Production on SPM machine (Projected)	Pcs/hr	300
Specific power consumption on SPM machine	kWh/Pcs	0.015
Reduction in specific power consumption	kWh/Pcs	0.075
Percentage savings	%	83.3
Operating hours	Hrs	8
Annual operating days	Days	300
Annual electricity savings	kWh	53,712
Annual cost savings	Rs.	413,100
Investment required	Rs.	550,000
Simple payback period	Years	1.33

As per the detailed calculations done, it is proposed to convert/ replace existing manual lathe machines to automatic Special Purpose Machines (SPMs). The specific power consumption on a manual machine is 0.015 kWh/ pcs whereas the specific power consumption in SPM machine would be around 0.075 kWh/pcs resulting in 83.3 % savings in electrical energy. The investment required for making an SPM machine would be around Rs 5.5 Lakhs with annual saving of Rs 4.13. The simple payback period of the technology is 1.33 years.

Annexure 1

Basic details and energy utilization pattern of Kalhon International

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Annexure 2

Energy saving calculation for Automatic SPM Lathe – Turning Machine

Parameter	Unit	Value
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Annual cost savings	Rs.	413,100
Investment required	Rs.	550,000
Simple payback period	Years	1.33

Note:

*** The cost of SPM machines is an indicative value gathered from discussions with SPM machine suppliers. It may vary from operation to operation and product to product.*